

REPORT OF SOIL INVESTIGATION
ON NEW DAM LOCATED AT
SHOOTERY, UTAH
FOR HYDRO JET SERVICES, INC.



CALDWELL, RICHARDS & SORENSEN, INC.

CONSULTING ENGINEERS

118 FIRST AVENUE, SALT LAKE CITY, UTAH

FIELDS OF SERVICE

AIRPORTS

**INDUSTRIAL, CHEMICAL
& COMMERCIAL**
SITE DEVELOPMENT
STRUCTURAL DESIGN
WASTE TREATMENT

MECHANICAL

BOILER PLANTS
HEAT DISTRIBUTION SYSTEMS
AIR CONDITIONING
HEATING
PLUMBING

REAL ESTATE

DEVELOPMENT
SUBDIVISIONS

ROADS

HIGHWAYS
MUNICIPAL STREET IMPROVEMENTS
COLLECTOR ROAD PROGRAM

SEWERAGE

COLLECTION SYSTEMS
PUMPING PLANTS
TREATMENT PLANTS

STORM DRAINAGE

FLOOD CONTROL
STORM DRAINS

SURVEYS

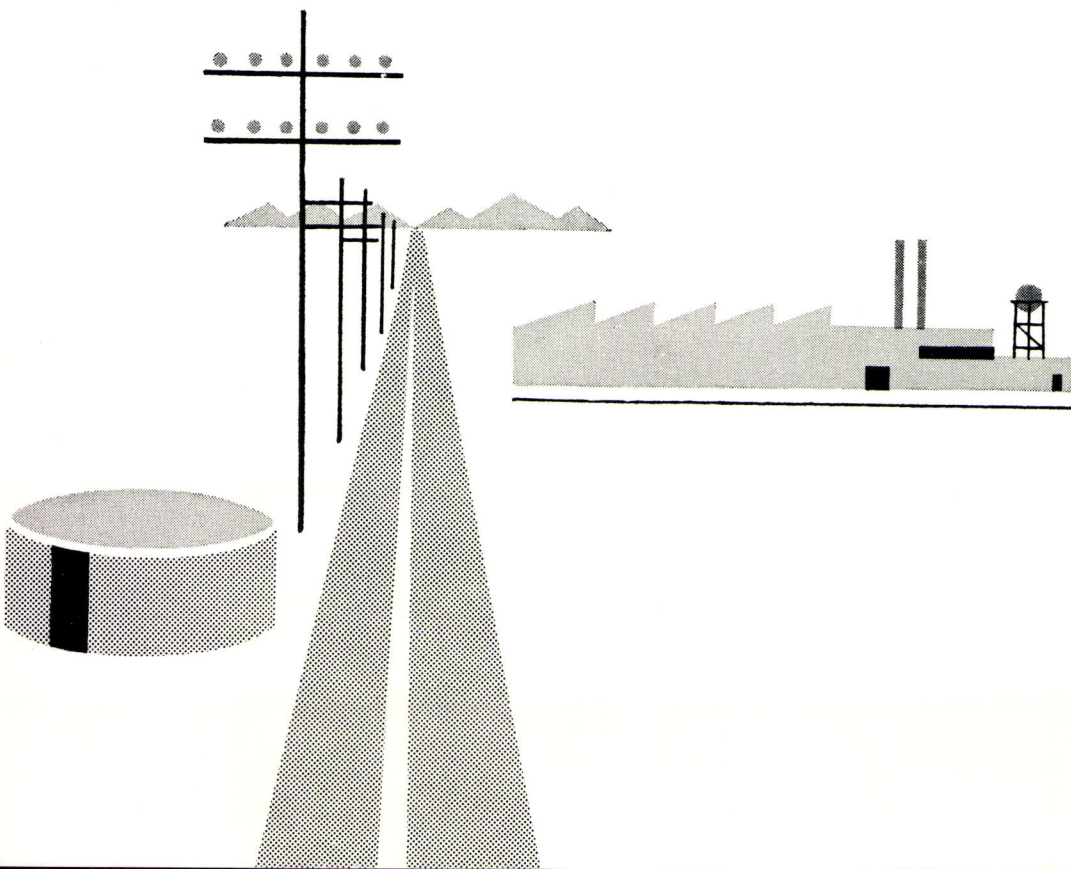
LAND SURVEYS
MAPPING
SUBDIVISIONS

TESTING & PROJECT SERVICE

SOIL INVESTIGATIONS & REPORTS
CONCRETE CURING & TESTING
CONSTRUCTION CONTROL
COMPACTION TESTING & CONTROL
CORROSION ENGINEERING

WATER SUPPLY

DAMS
FILINGS AND PROOFS
IRRIGATION & DRAINAGE
RESERVOIRS
TREATMENT PLANTS
DISTRIBUTION SYSTEMS
WELLS



R. E. CALDWELL
(1905-1945)

"OVER SIX DECADES OF ENGINEERING SERVICE"

CABLE ADDRESS
C R & S SALT LAKE UTAH

A. Z. RICHARDS
(1905-1967)

CALDWELL, RICHARDS & SORESENSEN, INC.

CONSULTING CIVIL ENGINEERS

26 South State, Suite 300
Salt Lake City, Utah 84111

PHONE: 364-5691

December 6, 1976

Mr. Ron Daniels
Oil, Gas & Mining Divn.
Utah State Government
1588 West North Temple
Salt Lake City, Utah 84116

Subject: Dam located at Shootering, Utah, constructed by Hydro Jet Services, Inc.

Dear Sir:

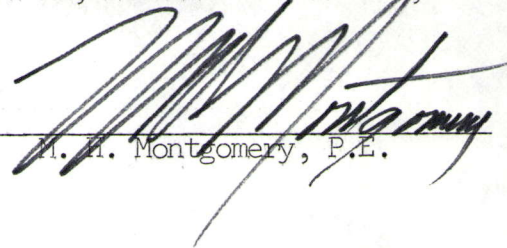
In accordance with our telephone conversation of December 6, we are handing you one copy of the Report of Soil Investigation on New Dam Located at Shootering, Utah.

Please review this soil investigation and call me, since I think we can resolve the problem by discussing it over the phone.

Yours very truly,

CALDWELL, RICHARDS & SORESENSEN, INC.

By


M. H. Montgomery, P.E.

MHM:klm

Enclosure

*Testing & Service Engineers
1152 Richards St.
364-5712*

File in ACT-017-001

REPORT OF SOIL INVESTIGATION
ON NEW DAM LOCATED AT
SHOOTERY, UTAH
FOR HYDRO JET SERVICES, INC.

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R. E. CALDWELL
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C ALDWELL, R ICHARDS & S ORENSEN, INC.

CONSULTING CIVIL ENGINEERS

118 FIRST AVENUE
SALT LAKE CITY, UTAH 84103
PHONE: 364-5691

November 12, 1976

Hydro Jet Services, Inc.
Box 325
Green River, Utah

Subject: Soil Investigation on existing Dam Site, located at
Shootery, Utah

Gentlemen:

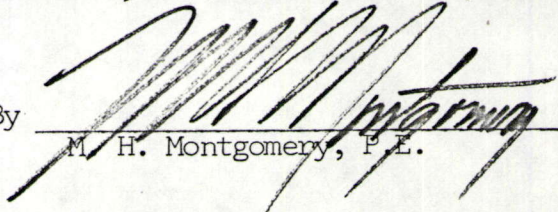
In accordance with authorization of Mr. Duane Frandsen on October 18, 1976, we have completed a soil investigation and have prepared a report to determine various characteristics of the existing dam.

The following report indicates our findings and we trust this will be sufficient for you to discuss the condition of the dam with the Utah State Officials.

Sincerely,

CALDWELL, RICHARDS & SORENSEN, INC.

By


M. H. Montgomery, P.E.

MHM:klm

REPORT OF SOIL INVESTIGATION
ON NEW DAM LOCATED AT
SHOOTERY, UTAH
FOR HYDRO JET SERVICES, INC.

SCOPE

We have examined the existing dam to determine the degree of compaction of the soil and furnish other information which could be used for analyzing the stability of the structure. Our investigation included the drilling of five test borings at locations determined jointly with a representative of Hydro Jet Services, Inc. and Dave Siebach, Technician. These test borings are considered to represent the soil type of which the dam is constructed.

All test borings were advanced to depths indicated on the enclosed log sheets utilizing a CME Rotary Drill Rig and standard soil sampling equipment. The elevations at the top of the test borings were given us by the local civil engineer. All borings were made primarily to:

1. Determine the degree of compaction of the soil of the dam.
2. Supply information from test results so that stability calculations can be made.

The tests performed were to classify the soil, determine its shear strength, angle of internal friction, permeability, unit weight, and moisture content.

We have made comments relative to the probable stability of the dam based on the testing performed and engineering experience in soil foundation work.

GENERAL GEOLOGY AND SITE INFORMATION

The site of the dam which has been constructed is located at Shootery, Utah, approximately 240 miles south of Salt Lake City, about half-way between Hanksville and Bullfrog Basin Marina. According to information received at the site, the soil is part of the Summerville Formation. Free water was not encountered at any depth in any boring.

SOIL BORINGS & SAMPLING

Five test borings were made at the site at the locations indicated on the Test Boring Location Plan. These borings were located by Dave Siebach and a representative of Hydro Jet Services, Inc. Generally they were located so a profile of the dam could be established. The borings were made with a CME Rotary Drill rig equipped for dry sampling.

Our standard sampling procedure was performed on the project, with the modification that samples were obtained at approximately 2-1/2 foot intervals so that a unit weight could be determined throughout the soil mass.

To obtain soil samples suitable for laboratory testing, and to obtain information on the subsoils relative density, standard penetration tests were performed at locations indicated on the boring logs. The tests were performed by driving a standard 2-1/2" O.D. split tube sampler 18" into the undisturbed soil and determining the blows required to drive the sampler 1' using a 140# hammer falling 30". The number of blows per foot is indicated on the left of our boring log. Undisturbed samples of the subsoil, suitable for laboratory testing, were secured from thin wall brass liner rings. The undisturbed samples were sealed in special containers to prevent moisture loss and disturbance. These samples were then taken to the laboratory for testing.

LABORATORY TESTING

Laboratory testing was performed to classify the soil, determine its unit weight, moisture content, permeability, shear strength and angle of internal friction.

ANALYSIS

You will find by referring to the logs of borings that the unit weight of the soil varies from a low value of 101 pounds per cubic foot in Boring #2 to 110 pounds per cubic foot in Boring #4, the highest value found. An

average value for the entire depth was determined to be 104 pounds per cubic foot. The moisture content ranged from a low value of 5.1% in Boring #1 to a high value of 15% in Boring #2.

In order to compare the unit weight with the maximum obtained by performing a simulated Proctor T180 using 1/100 cubic foot of soil, it was found that the maximum density the soil could be compacted to was 112 pounds per cubic foot at 16% moisture. Since the average soil density of the dam is 104 pounds per cubic foot, the percent of compaction of the entire soil mass has an average value of 92.9%. *$D_r \approx 70-79\%$ BMB*

We have enclosed for your review a permeability test of the soil from Boring #2 at a depth of 7-1/2 feet, and as you will find based on the test made by Pittsburgh Testing Lab, the coefficient of permeability was found to be 4.6×10^{-1} ft/day, or 1.6×10^{-4} cm/sec. *just 1 sample BMB*

We have performed one shear test using a Housel shear machine adapted to normal loading. The results of this test indicate the angle of internal friction to be relatively high (37°) with cohesive shear strength being about 500 pounds per square foot. *which sample? BMB*

We were handed a sheet at the site indicating recommendations made by the Utah State in a memo including Item #7 requiring calculation of factor of safety of the dam. Due to the relatively high angle of internal friction and degree of compaction, we have made recommendations without making calculations on the factor of safety, since this will vary greatly depending on the placement of impervious soil on the up-stream side of the dam to greatly reduce the permeability through the dam. It is our opinion that failure may occur due to the high permeability which would result in the unit weight becoming the submerged value and also decreasing the shear strength.

CONCLUSION

Evidently, based on our findings, the soil which was used to build the dam has a relatively low cohesive shear strength and rests on a comparatively impervious base. Percolating water based on the relatively high permeability will act under a hydrostatic head and the supporting material will be decreased by the uplift pressure of the water.

It is our opinion that the dam has been compacted to a degree which is somewhat low, but within normal limits for the type of soil used. With this type of soil having a relatively high angle of internal friction and a shear strength of 500 pounds per square foot, the dam should be stable if a relatively impervious layer of soil is placed on the up-stream side to decrease the flow of water through the dam to an amount equal to 2.0×10^{-8} cm/sec.

Rip rap should be placed over the impervious soil so that there will be no washing away of the impervious layer. *M.H. Montgomery suggested 12" rolled bentonite. B.W.B.*

We trust the report as submitted will allow you to proceed with correcting the condition of the dam without removing and replacing the existing soil.

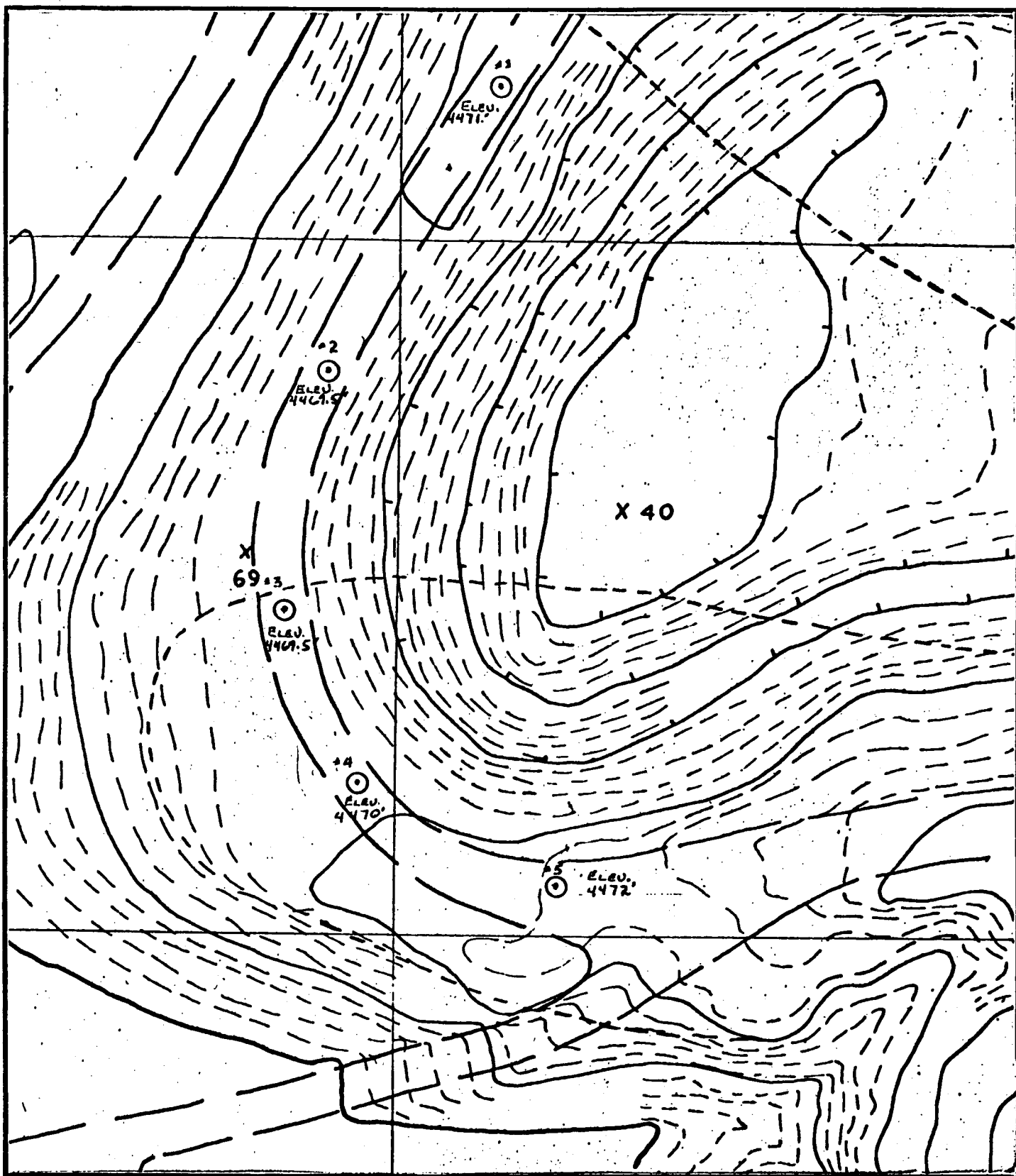


MHM:klm

Sincerely,

CALDWELL, RICHARDS & SORENSON, INC.

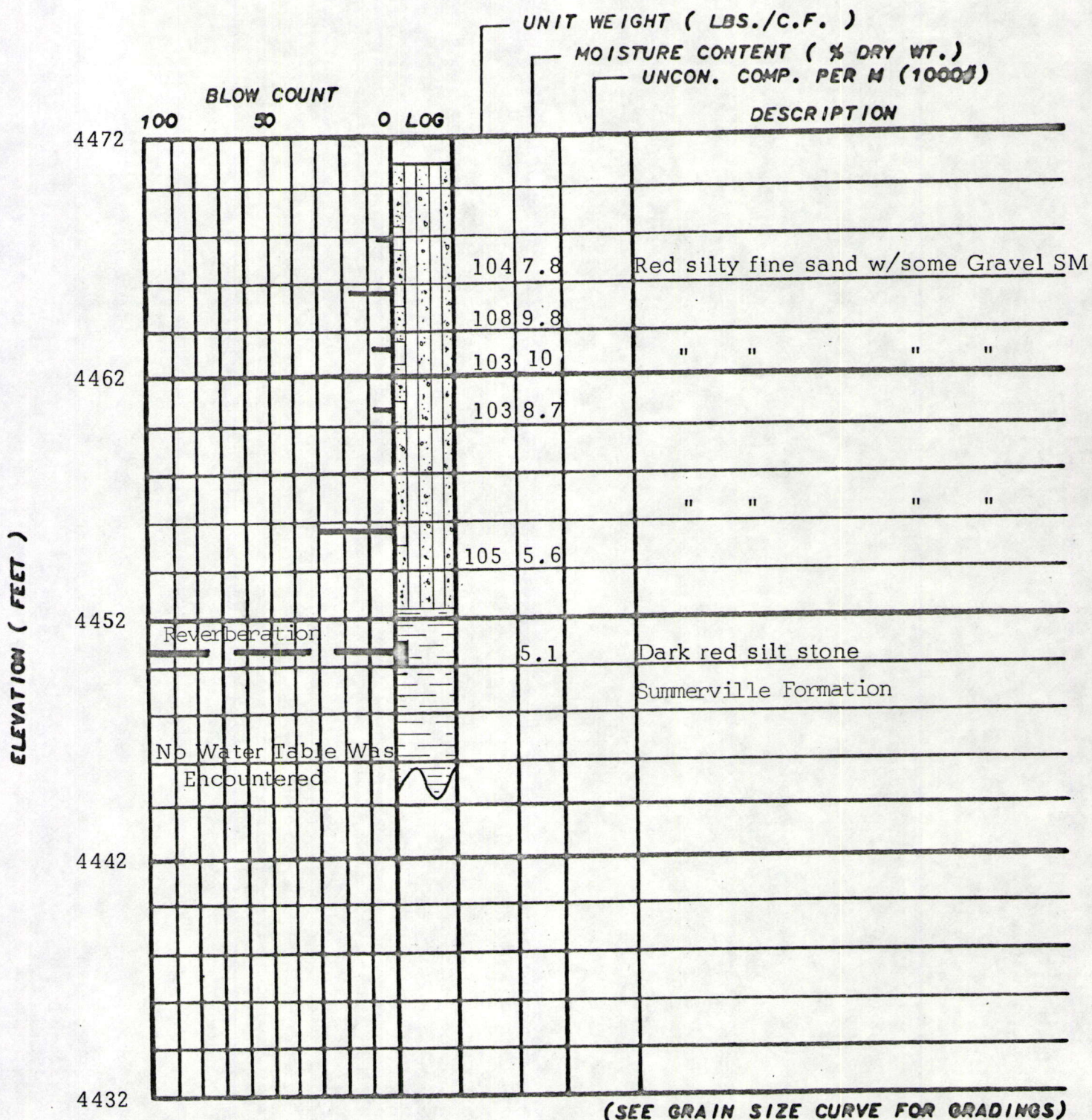
By 
M.H. Montgomery, P.E.



CALDWELL, RICHARDS & SORENSEN, INC.
118 First Avenue
Salt Lake City, Utah 84103

TEST BORING LOCATION PLAN
DAM AT SHOOTERY SITE - UTAH
FOR HYDRO JET SERVICES, INC.

Account No. 25-1033



TEST BORING NO. 1

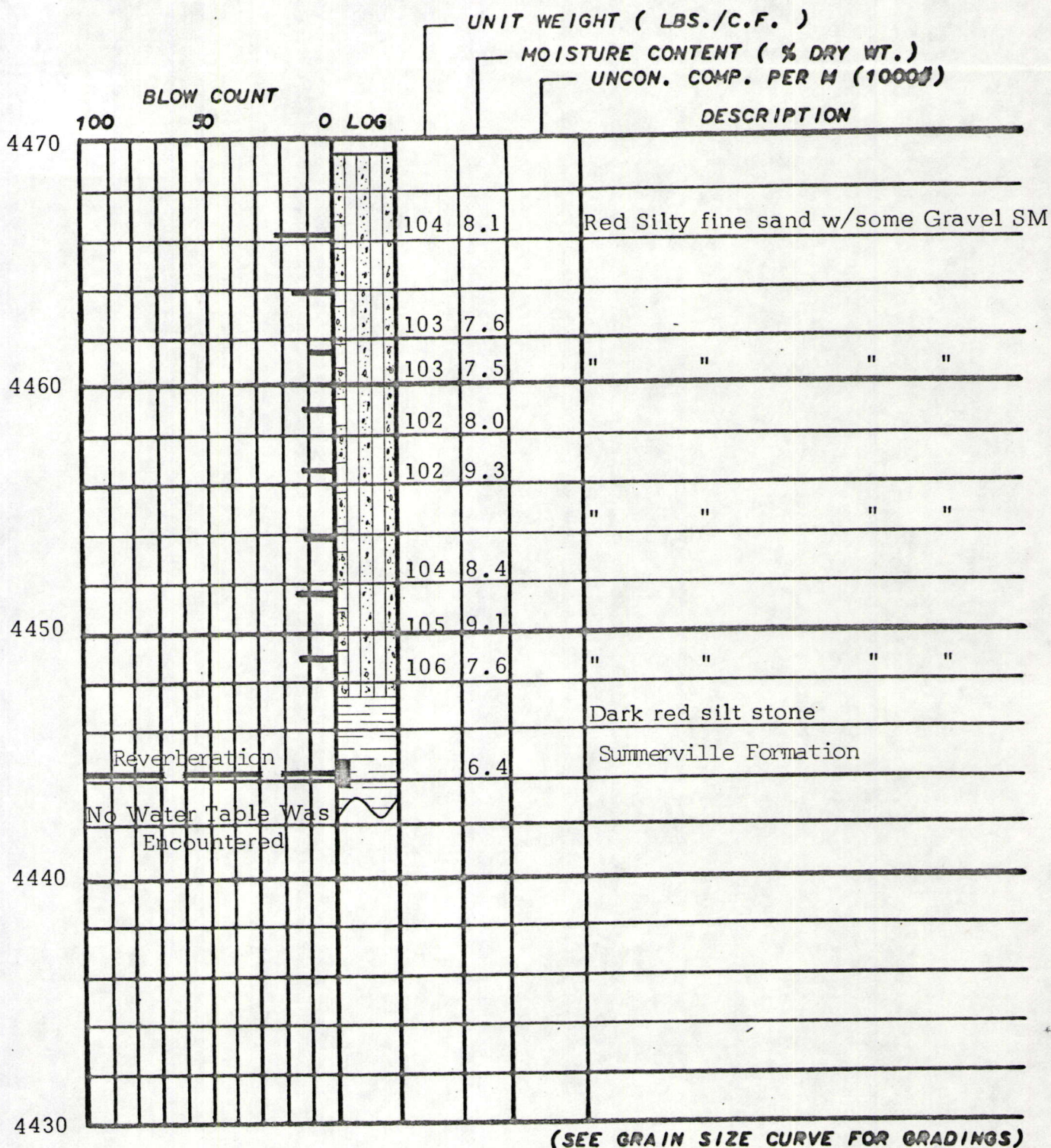
ELEVATION (FEET)	BLOW COUNT			LOG	UNIT WEIGHT (LBS./C.F.)	MOISTURE CONTENT (% DRY WT.)	UNCON. COMP. PER M (1000%)	DESCRIPTION
	100	50	0					
4470								
					103	8.6		Red silty fine sand w/some Gravel SM
					102	10		
					102	15		" " " "
4460					102	12		
					101	11		
					102	11		" " " "
					103	12		
4450					104	10		" " " "
								No Water Table Was Encountered
								Dark red silt stone
								Summerville Formation
4440								
4430								

(SEE GRAIN SIZE CURVE FOR GRADINGS)

TEST BORING NO. 2

PROJECT NO. 25-1033

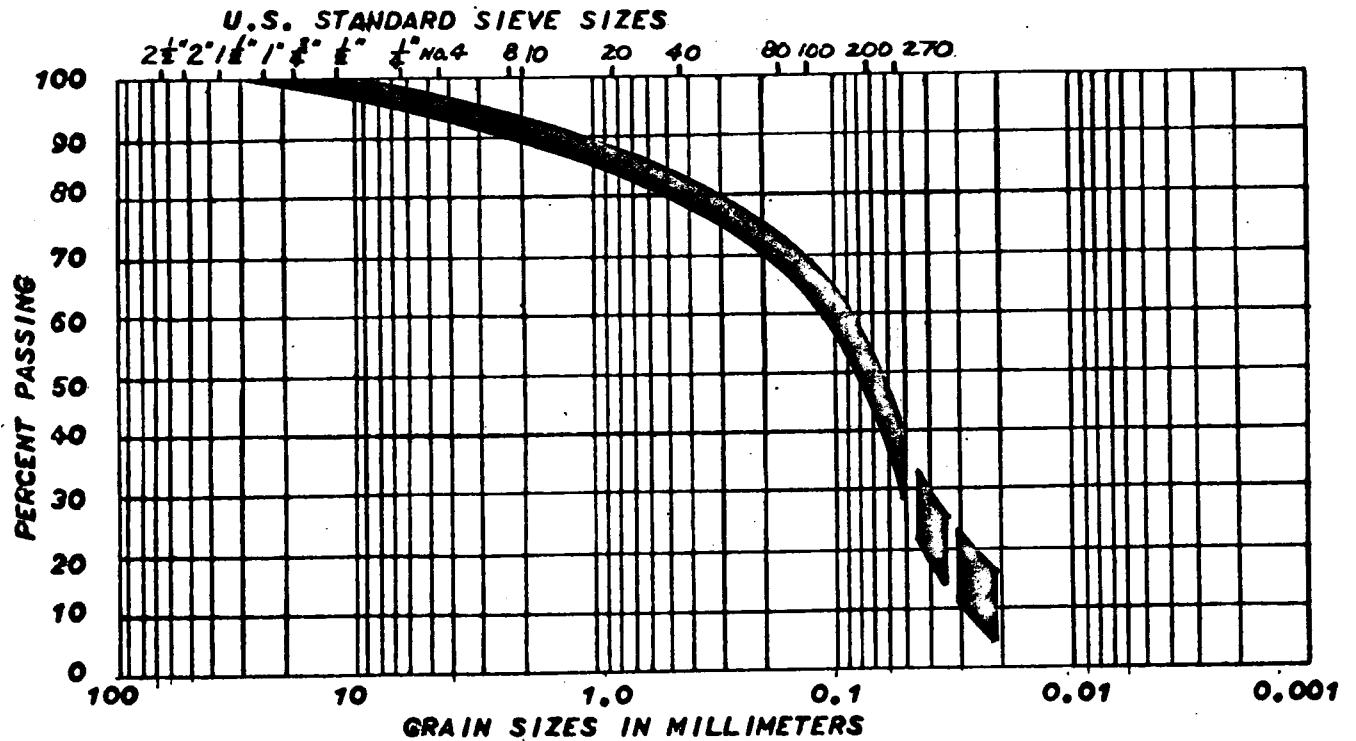
ELEVATION (FEET)



TEST BORING NO. 3

[illegible]

GRAVEL		SAND		SILT	CLAY
COARSE	FINE	COARSE	FINE		



AVERAGE BAND CURVE OF SAMPLES FROM SITE

GRAIN SIZE DISTRIBUTION CURVE

COMPUTATION SHEET

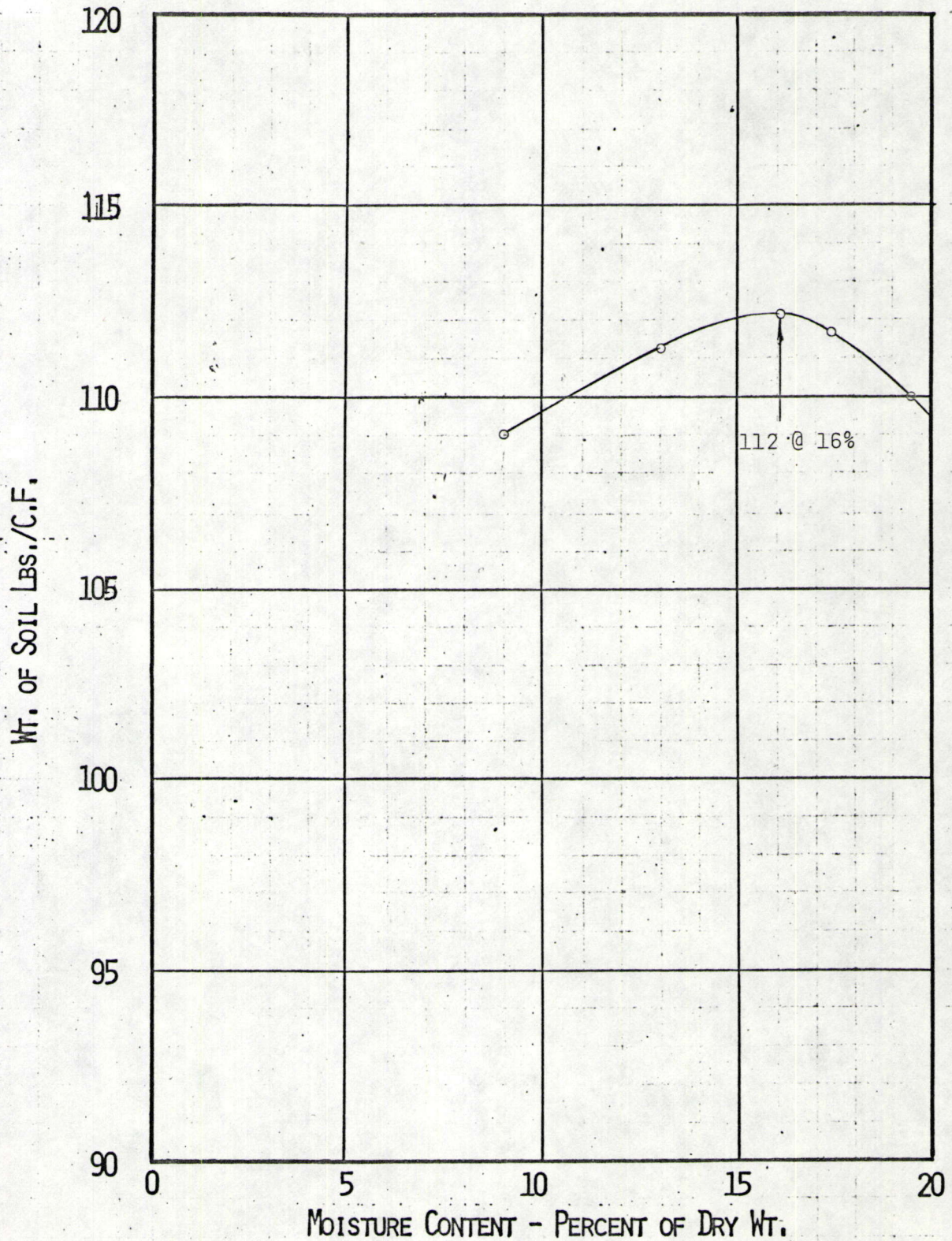
CALDWELL, RICHARDS & SORENSEN, INC.
Engineers & Consultants
Salt Lake City, Utah

By D S
Ck by M H M

Date 11-9-76
Date 11-12-76

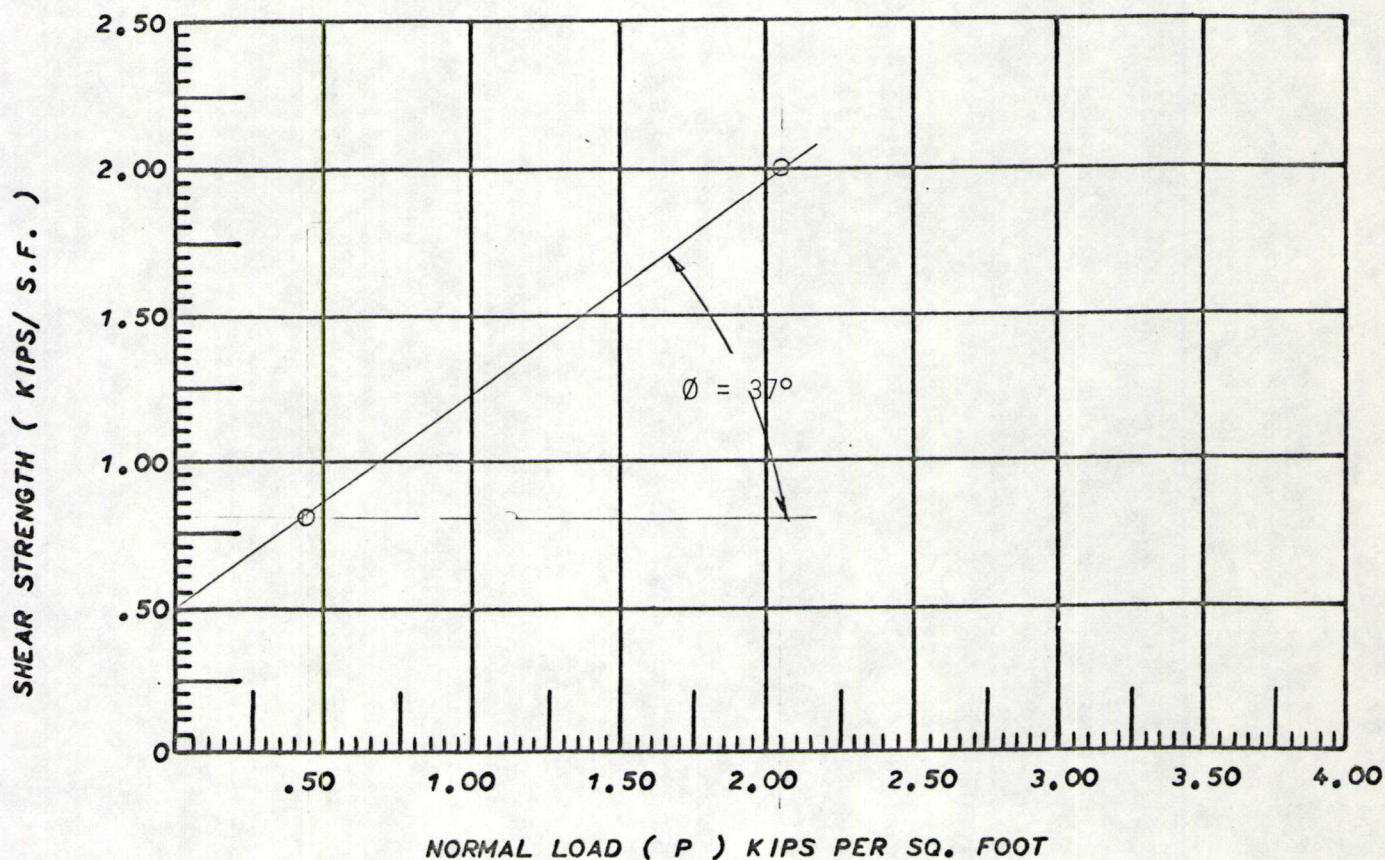
A/c No. 25-1033
Sht. No.

PROJECT Dam Site at Shootery, Utah
Hydro Jet Services, Inc.



MAXIMUM DENSITY CURVE USING MODIFIED PROCTOR T-180
(Simulated using 1/100 c.f. Sample)

DIRECT SHEAR TEST RESULTS



TEST DATA

SAMPLE NO. 2 AT 7-1/2' DEPTH

SOIL MATERIAL TYPE Red silty sand (with some gravel)

CONDITION OF SAMPLE Good

MOISTURE CONTENT 15 %

TYPE OF SHEAR TEST Housel (double shear)

DATE: Nov. 8, 1976

PROJECT NO. 25-1033

Caldwell, Richards & Sorensen, Inc.
118 First Avenue
Salt Lake City, Utah 84103

Dam at Shootery, Utah
Hydro Jet Services, Inc.